Geoscientific

Model Development

Discussions

GMDD

Interactive

comment

Interactive comment on "FESOM-C: coastal dynamics on hybrid unstructured meshes" *by* Alexey Androsov et al.

Anonymous Referee #2

Received and published: 9 November 2018

General comments:

Modelling coastal dynamics on unstructured meshes poses - although a number of models and discretization already exists – still a number of challenges concerning stability, efficiency and performance compared to observations. The paper addresses these questions and describes a possible solution by using the proposed hybrid finite-volume cell vertex discretization. I appreciate the detailed level of description and recommend publishing it with some revisions. The overall presentation is well structured and clear, although some more explanations in the text would help the reader to follow the arguments and descriptions. The article tries to cover the mathematical description, testing and validation/real cases, which is a lot for just one article. Each part could easily be extended to be more valuable. Especially the conclusion that the re-

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sults qualitatively and quantitatively agree with observation is not thoroughly supported by the presentation in the article (most of the German water level stations are missing like e.g. Cuxhaven).

Specific comments:

1.) Page 2 , Line 31: Describing the approximations as "traditional" is bit too vague. I recommend to make a reference or name it properly.

2.) Page 4, Line 10: Is there any reference or reasoning, why choosing the boundary conditions that way?

3.) Page 4, Line 14-15: This is quite short. To be complete I would expect a more detailed description about how to solve the kinetic energy equation in general or leave it completely for an appendix.

4.) Page 6, Line 6: What is taken as tau_0 and tau_gamma in the experiments?

5.) Page 8, Line 7: Why division by H in definition of delta_iˆk? Or what is Delta_i exactly?

6.) Page 8, Line 16: I don't understand the sentence "It also improves . . .. elevation gradient"

7.) Page 8, Line 19: If flux form is used in the temperature equation, it should be introduced before. It is not clear to me, why in the eq. in l. 23 the Delta only has the index i and not k.

8.) Page 9, Line27: What is meant by "full layers"? At cell surface or bottom?

9.) Page 10, Line 14-17: Maybe the reformulation and the matrices could be given in more details in an appendix?

10.) Page 10, Line 20: Define scalar control volumes

11.) Page 11: As there are several possibilities: How do you compute layer thickness

for the tracer advection?

12.) Page 12, Line 4: What is meant by "symmetrized following the standard practice" exactly? Give at least a reference.

13.) Page 12, Line 10: This is a trivial equation. Maybe there is something missing?

14.) Page 12, Line 14: Do you call it the "harmonic discretization" or is there any reference to former work, where it is properly defined or derived?

15.) Page 12, Line 18-20: The equivalence and the trivial adjustments are not obvious for me. Could you explain a bit more.

16.) Page 13, Line 8-10: It is a pity that these simpler experiments and especially the learned lessons are not published. It would advance the understanding of the problematic issues other developers may also be struggling with.

17.) Page 13ff: What values for tau_2d and tau_3d are used in the experiments (for real cases and the numerical performance test)?

18.) Page 13ff: As several discretization schemes are presented in Section 2, 3 and 4, which ones are actually used in the experiments? Otherwise present only the ones used.

19.) Page 13: What open boundary forcing is used in the Sylt-Romo experiment?

20.) Page 14: What time scale tau_f is used in the experiments? How much additional dissipation is added in comparison to other terms in momentum equations?

21.) Page 14, Line 19: Fig 5 and Fig 6: A plot of the observations at low wind conditions and of the model results would help to see the "correspondence with observation".

22.) Page 15: A figure of the South-East North Sea grid would be nice. Why only 5 sigma layers are used compared to 21 in the other experiment?

23.) Page 15: What simulation period is taken for the South-East North Sea experi-

ment? Which T&S forcing has been taken at the river Elbe input?

24.) Page 16, Line 1: What is "reasonably well"? Give statistical numbers or compare to other model results.

25.) Page 16, Line 7-9: To my opinion the Elbe fresh water plume is further north than in the observation.

26.) Page 16, Line 23: Is the viscosity smaller because less filtering has been applied on the quadrilateral mesh? Or were other parameters also changed? A table with the used parameters for each mesh and experiment would be nice.

27.) Page 17, Line 4: What is antiphase?

28.) Page 18: The code is not available for non-dkrz users (FAIR principles).

Technical corrections:

1.) When writing equations please use one line for one equation, not several equations in one line (e.g. p. 4 l. 10 or p.5 l. 25).

2.) p. 5 l. 11: formultion -> formulation

3.) p.7 l. 19: I don't' see tau_s and tau_b in the equations

4.) p.8 l. 22: termal -> thermal

5.) p.10, l. 1: Here a reference to Fig. 1 would be nice

6.) p.10, l. 3: elements = cell centers?

7.) p.10, l. 30: The information that the cell thickness is estimated at cell centers should be given before the two equations of the momentum advection

8.) p.11, l. 4: Put Miura,2007 in brackets

9.) p.11, l. 12: With left and right segments is meant s_l and s_r? Better write it and refer to Fig.1

10.) p.11, l. 20: Make reference to Fig.1 for definition of ny_1

11.) p.11, l. 25: zero flux at the bottom is Eq.8? Maybe refer to it as well?

12.) P.12, l. 13: points are collinear, vectors are parallel.

13.) p.14, l. 8: For "differences in the elevation" give reference to Fig.8.

14.) p.14, l. 16: Figure 6 -> Fig.6

15.) p.15, l. 10: write out sigma, not greek letter

16.) p.16, l. 4: Give reference for the 0.35PSU/km

17.) Fig. 2.: Check caption: no comparison with GETM was carried out, no points P1 and P2 are mentioned in the text.

18.) Fig. 4: The pictures should be bigger. It is not possible to see the current arrows and the legend. Depth is shown with respect to what? NN? Check caption: Is "full ebb" the time of maximum ebb speed? Maybe better give time after high water or low water.

19.) Fig. 6: For the middle and the bottom panel add the displayed day in the caption.

20.) Fig. 8: Check caption: "Spatial difference of the elevation" =? Spatial distribution of the elevation differences?

21.) Fig. 10: The numbers of the stations are hardly visible. Increasing the size of the pictures could help.

22.) Fig. 11: The caption needs to be rewritten because seemingly the lower panel does not show the running mean. The stations position could be shown in Fig 10.

23.) Fig. 12: Why are the dry falling areas masked out in Fig. 12? It would be nice to add a coastline in Fig. 12.

24.) Fig. 13: Add in the caption to which mesh the red and black line refer to.

Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-112, 2018.